DOI: 10.4274/jmsr.galenos.2026.2026-2-1

J Mult Scler Res 2026;6:46-49

CASE REPORT

Multidomain Functional Improvement in a Wheelchair-dependent Patient with Very Early-onset Secondary Progressive Multiple Sclerosis Following a Device-free SONAPS Program: A Case Report

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Abstract

Clinically meaningful functional improvement in advanced secondary progressive multiple sclerosis (SPMS) is uncommon. A 34-year-old man with very early-onset multiple sclerosis, currently classified as SPMS, completed a device-free, non-pharmacological SONAPS program (19 sessions over approximately 120-150 days). At baseline, the patient was fully wheelchair-dependent and exhibited severe multidomain impairment. Composite disability assessed using the Composite Disability and Functional Status Scale improved from 38/50 to 15/50. Improvements were observed across physical, functional, and psychological domains and were accompanied by gains in muscle strength (upper limbs: 3→4; lower limbs: 0→2, Medical Research Council Scale). Functional improvements were corroborated by video-documented observations and supported by descriptive graphical representations. No adverse events were reported. This hypothesis-generating observation suggests that multidomain functional improvement may be achievable in advanced SPMS. However, controlled and blinded studies are required to confirm these findings.

Keywords: Secondary progressive multiple sclerosis, wheelchair dependence, SONAPS program, non-pharmacological intervention, multidomain functional improvement

Introduction

Secondary progressive multiple sclerosis (SPMS) is characterized by the progressive accumulation of neurological disability with limited potential for recovery (1-3). Functional improvement in advanced disease, particularly among patients with prolonged wheelchair dependence, is considered uncommon (1).

Non-pharmacological interventions in progressive MS typically demonstrate modest and domain-specific effects (4). Reports describing rapid multidomain improvement remain rare.

The somatic-neuropsychological adaptive programming system (SONAPS) framework is a non-pharmacological, non-invasive, and device-free intervention designed to facilitate adaptive regulation across physical-structural-functional (PSF) and psychological-behavioral-cognitive (PBC) domains.

Case Report

A 34-year-old male diagnosed with multiple sclerosis at 16 years of age following an initial episode of optic neuritis presented with progressive neurological decline consistent with SPMS (2). The disease duration was approximately 16 years. The patient had been wheelchair-dependent for approximately four years prior to presentation. A schematic overview of the patient's clinical course is presented in Figure 1.

Written informed consent was obtained from the patient for the publication of this case report, including accompanying clinical images and videos.

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Received: 16.02.2026 **Accepted:** 15.05.2026 **Publication Date:** 03.06.2026

Cite this article as: Najafpour H, Riazat A. Multidomain functional improvement in a wheelchair-dependent patient with very early-onset secondary progressive multiple sclerosis following a device-free SONAPS program: a case report. J Mult Scler Res. 2026;6:46-49

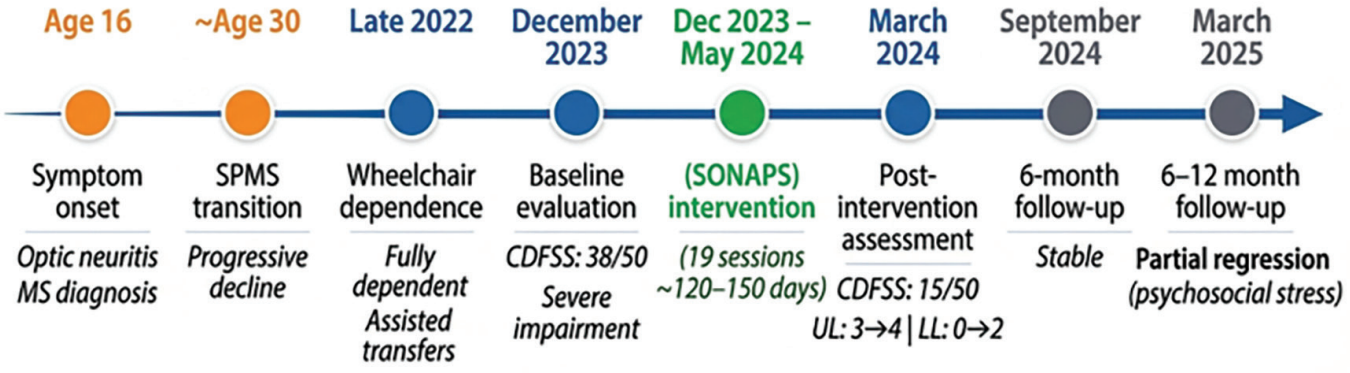

Figure 1. CARE-compliant timeline of the patient's clinical course from symptom onset through the 12-month follow-up after the SONAPS intervention

SONAPS: Somatic-neuropsychological adaptive programming system, CDFSS: Composite Disability and Functional Status Scale

Baseline Symptoms

- Severe lower-limb weakness and spasticity
- Upper-limb tremor
- Neuropathic pain
- Urinary dysfunction
- Severe insomnia
- Cognitive fatigue and anxiety

Neurological Examination

- Lower-limb strength: 0/5 bilaterally
- Upper-limb strength: 3/5
- Positive bilateral Babinski signs
- Impaired trunk control and balance

Baseline Disability

Composite Disability and Functional Status Scale (CDFSS) score: 38/50

SONAPS Intervention

The patient completed 19 sessions (approximately 120 minutes each) over a period of 90-110 days.

SONAPS is a structured, non-invasive, and device-free intervention that operates within an adaptive closed-loop clinical framework integrating PSF and PBC domains. The intervention content is dynamically adjusted according to patient responses during structured tasks.

The intervention was entirely device-free and consisted of structured, task-oriented sensorimotor and behavioral components.

Core elements included guided postural adjustments, coordination-focused motor tasks, graded muscle activation, and real-time therapist feedback based on observed patient responses.

No external devices, electrical stimulation, or pharmacological modifications were used during the intervention period.

Session Structure

Each session included the following components:

- Interval symptom review
- Structured assessment using PSF and PBC anchors
- Individualized multimodal intervention targeting:
  - Postural control
  - Sensorimotor integration
  - Coordination
  - Fatigue modulation
  - Behavioral and emotional regulation
- Adaptive task sequencing
- Post-session reassessment

Although individualized, all sessions followed a consistent structural framework to support conceptual reproducibility.

Outcome Measures

Primary Outcome

CDFSS

Secondary Outcomes

Muscle strength (Medical Research Council MRC scale)

Patient-reported symptom severity (0-10 scale)

Results

Composite disability improved from 38/50 to 15/50, representing an approximately 61% reduction (Table 1).

Subscale Changes

Physical: 19 → 8

Cognitive/psychological: 11 → 1

Functional: 8 → 6

Muscle Strength

Upper limbs: 3 → 4

Lower limbs: 0 → 2

Table 1. Prespecified outcomes before and after the SONAPS intervention

Domain	Measure	Baseline	Post
Disability	CDFSS	38	15
Strength	MRC upper limb	3	4
	MRC lower limb	0	2
PSF	Spasticity (0-10)	10	6
	Tremor (0-10)	10	4
	Balance limitation (0-10)	10	6
	Neuropathic pain (0-10)	9	5
PBC	Anxiety (0-10)	9	5
	Depression (0-10)	8	5
Cognition	Brain fog (0-10)	10	4

CDFSS: Composite Disability and Functional Status Scale, MRC: Medical Research Council Scale, PSF: Physical-structural-functional, PBC: Psychological-behavioral-cognitive

Functional Changes

Improved assisted sit-to-stand ability

Improved trunk stability

Improved fine motor control

Representative images of the patient's functional status before and after the intervention are presented in Supplementary Figures 1 and 2.

Changes in symptom severity and CDFSS subscale scores are presented in Figures 2A and B. No adverse events were observed.

Follow-up

At 6 months: Clinical status remained stable.

Between 6 and 12 months: Partial regression was observed during periods of psychosocial stress.

All outcomes should be interpreted as exploratory given the absence of validated measurement instruments.

Discussion

Functional improvement in advanced SPMS is uncommon due to progressive neurodegenerative mechanisms and limited recovery potential (1,3).

In this case, multidomain improvement was observed; however, causal inference cannot be established. Alternative explanations—including behavioral engagement, expectancy effects, and measurement bias—should also be considered.

The absence of standardized outcome measures [e.g., Expanded Disability Status Scale (EDSS), Timed 25-Foot Walk (T25FW),

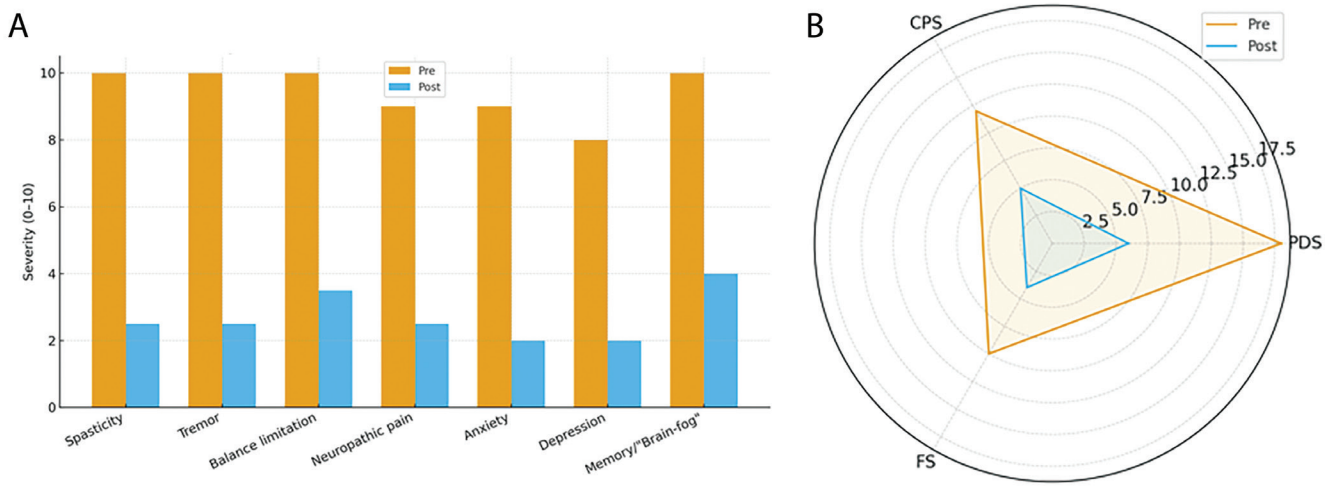

Figure 2. Changes in symptom severity and CDFSS subscale scores. **(A)** Changes in selected PSF and PBC symptom severity scores before and after the intervention (bar chart). **(B)** Changes in CDFSS subscale scores before and after the intervention (line graph)

PSF: Physical-structural-functional, PBC: Psychological-behavioral-cognitive, CDFSS: Composite Disability and Functional Status Scale

and Nine-Hole Peg Test (9HPT), baseline magnetic resonance imaging (MRI) data, and validated assessment tools further limits interpretability (4).

Neurobiological constraints related to aging and neuroplasticity may also limit recovery potential (5). Mechanistic interpretations remain speculative and require validation using objective neurophysiological methods, such as electroencephalography- or magnetoencephalography-based connectivity analyses (6,7).

Observed functional improvements were limited to assisted postural transitions and trunk control and did not include independent ambulation.

Study Limitations

Single-case, non-blinded design.

Absence of standardized outcome measures (EDSS, T25FW, 9HPT, and cognitive batteries).

No baseline MRI assessment.

Use of a non-validated CDFSS.

Reliance on subjective symptom ratings.

Conclusion

Multidomain functional improvement was observed in this case of advanced SPMS following a device-free intervention. These findings are exploratory in nature and require confirmation in controlled, blinded studies.

Ethics

Informed Consent: Written informed consent was obtained from the patient and participating family members for the publication of clinical information and video documentation.

Data Availability Statement

The clinical protocols and de-identified data supporting the findings of this case report are available from the corresponding author upon reasonable request. the SONAPS Clinic welcomes scientific inquiries and independent verification of the observed functional outcomes to support the development of structured non-pharmacological interventions in advanced MS.

Footnotes

Authorship Contributions

Surgical and Medical Practices: H.N., Concept: H.N., A.R., Design: H.N., Data Collection or Processing: H.N., Analysis or Interpretation: H.N., Literature Search: H.N., A.R., Writing: H.N., A.R.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study received no financial support.

Supplementary Figures 1 and 2: https://d2v96fxpocvxx.cloudfront.net/17d041fe-057c-4c8e-a75d-948e33c0152a/content-images/75b54567-8dfe-44ef-a892-9ef175f61658.pdf

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